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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| 10/807,236 | 03/24/2004 | Keiki Tanabe | 1602-0184PUS1 | 4507 |

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| EXAMINER | |
|---|---|
| NGUYEN, TU MINH | |

| ART UNIT | PAPER NUMBER |
|---|---|
| 3748 | |

DATE MAILED: 09/25/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 10/807,236 | TANABE ET AL. | |
| | Examiner | Art Unit | |
| | Tu M. Nguyen | 3748 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) 1-14 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-14 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 24 March 2004 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date 20040324.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

## DETAILED ACTION

### *Claim Rejections - 35 USC § 102*

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office Action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claims 1, 6, and 11-13 are rejected under 35 U.S.C. 102(e) as being anticipated by Sun et al. (U.S. Patent 6,826,902).

Re claim 1, as shown in Figures 1 and 6, Sun et al. disclose a method for estimating a NOx occlusion amount ($x_{NOx}$) of a NOx occlusion catalyst (36) interposed in an exhaust passage (42) in an engine (12), characterized in comprising the steps of:

- estimating (step 212) the NOx occlusion amount using a polynomial (equation (19) and the equation on lines 30-34 of column 11) reflected with a NOx occlusion characteristics (a NOx adsorption rate ($\dot{x}_a$))of the NOx occlusion catalyst, and

- correcting each coefficient of the polynomial sequentially on the basis of NOx purification rates actually measured (the coefficient $c_2$ on the right-hand-side of equation (19) is determined from experimental data (lines 7-8 of column 8) and is based on a NOx adsorption rate that is actually measured (see equation (4b) in column 7)).

Re claim 6, the method of Sun et al. is characterized in that a NOx discharging amount in the NOx occlusion catalyst is calculated according to the following equation:

NOx discharging amount = ∫ (reducing agent concentration at catalyst inlet x reducing agent utilization rate – a constant x oxygen concentration in catalyst inlet) x exhaust gas flow rate (See equation (4b) and lines 54-67 of column 8).

Re claim 11, the method of Sun et al. is characterized in that:

- the engine is constituted such that switching can be performed between a lean operation where an exhaust gas air-fuel ratio is lean and a rich operation where the exhaust gas air-fuel ratio is rich (lines 38-41 of column 3), and

- the coefficients of the polynomial are held during the rich operation, and when a difference between the NOx purification rate obtained by using the held coefficients at a starting time of the lean operation and the NOx purification rate actually measured is equal to or more than a threshold value, the NOx occlusion amount is corrected (coefficients $c_1$ and $c_2$ are based on experimental data and are corrected based on a measured changed of NOx adsorption or desorption rates).

Re claim 12, the method of Sun et al. is characterized in that the NOx occlusion amount is corrected, when a difference between an actually measured value of the NOx purification rate ($\dot{x}_a$, $\dot{x}_d$) at the starting time of the lean operation of the engine and an estimated value thereof is equal to or more than a threshold value.

Re claim 13, the method of Sun et al. is characterized in that the NOx occlusion amount is corrected based upon a judgment that a NOx occlusion amount calculated at the starting time

of the lean operation is incorrect when a difference between the NOx purification rate ($x_a$, $x_d$) estimated by the polynomial and the NOx purification rate obtained by actual measurement immediately after switching is performed from the rich operation of the engine to the lean operation thereof is equal to or more than a predetermined value.

***Claim Rejections - 35 USC § 103***

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office Action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 2-4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sun et al. as applied to claim 1 above, in view of Yang (U.S. Patent Application 2004/0261397).

Re claim 2, the method of Sun et al. is characterized in that the polynomial for obtaining the NOx occlusion amount which is used in the estimating step includes a NOx purification rate ($\dot{x}_d$), flow rate of NOx into the catalyst, and flow rate of CO into the catalyst, wherein these flow rates are a function of exhaust gas temperature, engine speed, and engine load.

Sun et al., however, fail to disclose that the above NOx and CO flow rates are converted to coefficients that are related to exhaust gas temperature and exhaust gas flow velocity so that the polynomial is a polynomial obtained by multiplying the exhaust gas temperature and the exhaust gas flow velocity by respective coefficients.

As shown in Figure 1a, Yang discloses a NOx control apparatus for an internal combustion engine comprising a NOx occlusion catalyst (105). As indicated in paragraphs 0016-0021 and 0024-0028, Yang teaches that it is conventional in the art to estimate an NOx flow rate from the engine and a CO flow rate (ratio of CO and NOx) based on the parameters such as engine or exhaust gas temperature and exhaust gas space velocity; so that an NOx occlusion amount in the catalyst is characterized by these parameters. It would have been obvious to one having ordinary skill in the art at the time of the invention was made, to have utilized the teaching by Yang in the method of Sun et al., since the use thereof would have been routinely practiced by those with ordinary skill in the art.

Re claim 3, the modified method of Sun et al. is characterized in that the polynomial is expressed by an equation that includes coefficients multiplying with at least one of NOx purification rate, exhaust gas temperature, and exhaust gas space velocity.

Re claim 4, the method of Sun et al. is characterized in that the correcting step comprises, in an occasion of correcting the coefficient sequentially:

- estimating the (N+1)-th NOx purification rate on the basis of the N-th (N is a natural number) NOx occlusion amount obtained from the polynomial (see Figure 2 where a release rate and a storage rate of oxygen is sequentially determined based on a relatively oxygen level), and

- correcting each coefficient such that the estimated (N+1)-th NOx purification rate becomes the NOx purification rate actually measured.

5. Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sun et al. in view of Yang as applied to claim 4 above, and further in view of official notice.

The method of Sun et al. discloses the invention as cited above, however, fails to disclose that the method is further characterized in that the coefficient is corrected by using the method of least square.

It is well known to those with ordinary skill in the art that Sun et al. utilizes a well known curve fitting method of least square to correct the coefficients in the polynomial so that a predicted NOx occlusion amount in the catalyst is closely matched with a measured value. Therefore, such disclosure by Sun et al. is notoriously well known in the art so as to be proper for official notice.

6. Claims 7-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sun et al. as applied to claim 6 above, in view of Yang.

Re claim 7, in the method of Sun et al., a reducing agent utilization rate (see lines 50-67 of column 7) is characterized in a map (see Figure 2). They, however, fail to disclose that the reducing agent utilization rate is further set on the basis of exhaust gas temperature and exhaust gas flow velocity.

As shown in Figure 1a, Yang discloses a NOx control apparatus for an internal combustion engine comprising a NOx occlusion catalyst (105). As indicated in paragraphs 0024-0028, Yang teaches that it is conventional in the art to estimate an NOx reduced or desorption rate based on the parameters such as engine or exhaust gas temperature and exhaust gas space velocity; so that a reducing agent utilization rate by the catalyst is characterized by these parameters. It would have been obvious to one having ordinary skill in the art at the time

of the invention was made, to have utilized the teaching by Yang in the method of Sun et al., since the use thereof would have been routinely practiced by those with ordinary skill in the art.

Re claim 8, the modified method of Sun et al. is characterized in that:

- the reducing agent utilization rate is estimated using a polynomial (see equation 4(b)) which is reflected with a NOx discharging characteristics of the NOx occlusion catalyst, and

- the coefficients of the polynomial are sequentially corrected on the basis of the concentration of reducing agent.

Re claim 9, the modified method of Sun et al. is characterized in that:

- the polynomial for obtaining the reducing agent utilization rate includes a catalyst inlet reducing agent concentration (line 6 of column 6),

- an exhaust gas temperature and an exhaust gas flow velocity (see paragraphs 0024-0028 in Yang), and

- the polynomial is a polynomial obtained by multiplying the catalyst inlet reducing agent concentration, the exhaust gas temperature, and the exhaust gas flow velocity by respective coefficients.

Re claim 10, the modified method of Sun et al. is characterized in that the polynomial for the reducing agent utilization rate is expressed by an equation that includes coefficients multiplying with at least one of a catalyst inlet reducing agent concentration, exhaust gas temperature, and exhaust gas space velocity.

7. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sun et al. as applied to claim 1 above, in view of official notice.

The method of Sun et al. discloses the invention as cited above, however, fails to disclose that the method further judges that the catalyst is abnormal when an average value of the each coefficient in a predetermined period is deviated from a predetermined range.

It is well known to those with ordinary skill in the art that Sun et al. monitor a computed NOx occlusion amount with a measured value during a purging period of the NOx occlusion catalyst; and they judge that the catalyst is abnormal when an average value of the each coefficient in said purging period is deviated from a predetermined range. Therefore, such disclosure by Sun et al. is notoriously well known in the art so as to be proper for official notice.

***Prior Art***

8. The IDS (PTO-1449) filed on March 24, 2004 has been considered. An initialized copy is attached hereto.

9. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure and consists of five patents and two patent applications: Poggio et al. (U.S. Patent 6,327,848), Kolmanovsky et al. (U.S. Patent 6,347,512), Takaku et al. (U.S. Patent 6,383,267), Surnilla et al. (U.S. Patent 6,622,476), Surnilla et al. (U.S. Patent 6,684,631), Nakagawa et al. (U.S. Patent Application 2004/0211171), and Sunohara et al. (U.S. Patent Application 2006/0064968) further disclose a state of the art.

***Communication***

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Examiner Tu Nguyen whose telephone number is (571) 272-4862.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mr. Thomas E. Denion, can be reached on (571) 272-4859. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Tu M. Nguyen

TMN

September 18, 2006

Tu M. Nguyen
Primary Examiner
Art Unit 3748